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Birth Weight and Post-weaning Failure to Thrive Affect Subsequent Growth Performance, but Not Nursery Nutrient Digestibility or Carcass Composition of Pigs

A.S. Leaflet R2733

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Summary and Implications

Numerous factors, including birth weight, can affect transition during weaning. The objective of this experiment was to evaluate the effects of birth weight and transition ADG on growth and nutrient digestibility of pigs reared in a commercial environment. A total of 1,500 pigs were weighed at birth, tagged, and divided into 5 birth weight categories: <1 kg, 1-1.25 kg, 1.25-1.5 kg, 1.5-1.75 kg, >1.75 kg. At weaning, 1,054 pigs were moved to a commercial wean-to-finish research barn. All pigs were weighed individually at 0, 3, 6, and 22-weeks post-weaning. Gain from 0 to 3-weeks post-weaning was calculated and termed 'transition ADG.' Pigs from 3 transition ADG percentiles were of interest: 10^{th}, 30^{th}, and 70^{th}. Forty pigs from each of these three transition ADG categories were matched for sex, litter number born alive, and sow parity to create 20 matched sets for 60 total pigs. At 3-weeks post-weaning, the 20 sets of pigs were harvested for whole-body carcass composition, and rectal digesta samples were collected to determine nutrient digestibility. All other pigs remained in the barn and were raised under typical commercial conditions. Data were analyzed using PROC GLIMMIX. There were no birth weight × transition ADG interactions ($P > 0.27$). Birth weight affected ($P < 0.05$) all weight and ADG periods except ADG from weaning to 3-weeks post-weaning ($P = 0.78$). Transition ADG affected ($P < 0.0003$) all weight and ADG periods. In particular, pigs from the 10^{th} percentile were nearly 5 kg lighter than pigs from the 70^{th} percentile by week 6 post-weaning, and over10 kg lighter by 22 post-weaning. There was no effect ($P > 0.11$) of birth weight or transition ADG on nutrient digestibility or carcass composition. In conclusion, both light birth weight and post-weaning failure is a substantial source of weight variation at closeout, but this variation cannot be attributed to differences in nutrient digestibility.

Introduction

Research has demonstrated that the last decade's unprecedented rise in litter size has resulted in an increasing number of light birth weight pigs. During this same time frame, there has been a high incidence of pigs that fail to thrive immediately post-weaning, but the link between birth weight and post-weaning performance has not been proven. It has been hypothesized that light birth weight pigs have poorer post-weaning growth performance, which can be attributed to differences in nutrient digestibility. However, few experiments have examined these associations, and to our knowledge, none have been conducted in a commercial environment. Therefore, the objective of this experiment was to evaluate the effects of birth weight and transition ADG on subsequent growth performance and nutrient digestibility of pigs reared in a commercial environment.

Materials and Methods

This study was conducted at a commercial sow farm and wean-to-finish facility in Iowa under the approval of the Institutional Animal Care and Use Committee (#2-11-7095-S). In a commercial sow farm, a total of 1,500 pigs were weighed immediately at birth, individually tagged, and divided into 5 birth weight categories: <1 kg, 1-1.25 kg, 1.25-1.5 kg, 1.5-1.75 kg, >1.75 kg. At weaning, 1,054 random pigs were moved to a commercial wean-to-finish research barn with 40 pens. All pigs were weighed individually at 0, 3, 6, and 22-weeks post-weaning. Gain from 0 to 3-weeks post-weaning was calculated and termed 'transition ADG.' Pigs from 3 transition ADG percentiles were of interest: 10^{th}, 30^{th}, and 70^{th}.

Forty pigs from each of these three transition ADG categories were matched for sex, litter number born alive, and sow parity to create 20 matched sets for 60 total pigs. At 3-weeks post-weaning, the 20 sets of pigs were harvested, and rectal digesta samples were collected to determine nutrient digestibility. Whole carcasses, including head and feet, were emptied of digesta, ground, and subsampled. Samples were freeze-dried, ground through a 2-mm screen, and analyzed for percentage water, protein, fat, and ash, as well as total gross energy. Feed and fecal samples were oven-dried, ground through a 1-mm screen, and analyzed for DM, N, ash, and GE digestibility. All other pigs remained in the barn and were raised under typical commercial conditions.

Data were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC), with pig as the experimental unit. The fixed effects were birth weight and transition ADG. There were no birth weight × transition ADG interactions ($P > 0.27$) for any measured variables, so the term was removed from the model. When analyzing the digestibility and carcass data, matched set served as a random effect, which included the effects of sex, number born alive, and sow parity. This allowed for the main effects of birth weight and transition ADG to be evaluated as an

unbalanced 5 × 3 factorial design, while equalizing other possible confounding factors. Results were considered significant or trends if their *P*-values were < 0.05 or < 0.10, respectively.

Results and Discussion

Birth weight affected ($P < 0.05$) all weight and ADG periods except ADG from weaning to 3-weeks post-weaning ($P = 0.78$; Table 1). A 1-kg difference in birth weight between the lightest and heaviest birth weight categories resulted in a 2-kg difference by weaning over 10-kg difference by closeout. However, pigs with birth weights in the 1-1.25 kg category had statistically similar ($P > 0.05$) closeout weights and overall post-weaning ADG as those from the heaviest birth weight category. This reinforces previous researchers' findings that pigs with birth weights less than 1 kg are the most detrimental to a producer's net income, and the economic viability of these pigs needs to be considered through various pig flows.

Transition ADG category was a good predictor of subsequent performance ($P < 0.0002$). In particular, pigs from the 10th percentile were 5 kg lighter than pigs from the 70th percentile by week 6 post-weaning, and over 8 kg lighter by week 22 post-weaning. However, closeout weights and overall post-weaning ADG of pigs from the 10th and 30th percentiles of transition ADG were statistically similar ($P > 0.05$). This finding suggests that the economic implications of post-weaning failure to thrive may reach beyond the bottom 10th percentile of pigs, particularly in commercial conditions.

While both birth weight and transition ADG have major impacts on subsequent growth performance, neither affect nutrient digestibility or carcass composition of pigs during the post-weaning transition period. Pigs from the lightest birth weight category (< 1 kg) had numerically lower apparent total tract digestibility of dry matter (71.7 vs. 72.5%), gross energy (72.1 vs. 73.5%), and nitrogen (66.6 vs. 68.0%) compared to pigs from the heaviest birth weight category (>1.75 kg. However, none of these values were statistically different ($P > 0.16$) due to high pig-to-pig variation. There were no statistical differences ($P > 0.43$) or large numerical differences in nutrient digestibility of pigs from different transition ADG categories.

It is important to note that digestibility values from this experiment are considerably lower than many published values from pigs of similar size and age. We believe the lower digestibility values can be attributed to differences in health from this commercial experiment compared to pigs housed in a typical university setting. Pigs from this experiment had a confirmed PRRS outbreak during the collection period. This health challenge may have decreased nutrient disappearance from the gut, and resulted in the lower than expected digestibility values.

Finally, neither birth weight nor transition ADG affected ($P > 0.11$) carcass composition of pigs at 3-weeks post-weaning. Numerically, pigs from the lightest birth weight category (< 1 kg) had carcasses with a lower percentage fat (11.7 vs. 14.3%) and higher percentage ash (3.6 vs. 2.7%) compared to pigs from the median birth weight category (1.25 - 1.50 kg). Still, there was too much variation for these responses to be statistically significant.

Overall, these data confirm that light birth weight and post-weaning failure is a substantial source of weight variation at closeout. However, this variation cannot be attributed to statistical differences in post-weaning nutrient digestibility or reflected in differences in carcass composition. Producers must carefully manage pigs that weigh less than 1 kg at birth and pigs with poor post-weaning growth in order to maximize barn performance.

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Table 1. Effects of birth weight or transition ADG on post-weaning (PW) growth performance[1]

	Birth Weight Category						Transition ADG Category			
	<1.00	1.00-1.25	1.25-1.50	1.50-1.75	>1.75	Pooled SEM	10th	30th	70th	Pooled SEM
n =	131	244	320	256	103		107	127	131	
Weight, kg										
Birth	0.9	1.1	1.4	1.6	1.9	0.01	-	-	-	-
Weaning	4.0	4.6	5.2	5.7	6.0	0.12	-	-	-	-
Week 3 PW	6.7	7.3	8.0	8.5	8.6	0.13	6.7	7.8	9.0	0.09
Week 6 PW	11.3	13.1	14.0	13.4	14.7	0.39	11.4	13.4	15.6	0.29
Week 22 PW	97.0	100.7	103.9	105.6	108.3	1.47	99.4	102.1	107.8	1.60
ADG, g/d										
Birth to wean	189	208	232	249	248	7.3	-	-	-	-
Week 0 to 3 PW	153	153	153	153	148	2.3	87	151	218	1.7
Week 3 to 6 PW	216	272	286	278	283	16.1	221	264	316	11.9
Week 6 to 22 PW	781	808	830	838	857	17.9	791	814	863	13.2
Week 0 to 22 PW	588	609	625	631	645	13.5	596	613	650	9.9

[1]There was no interaction ($P > 0.27$) between birth weight and transition ADG category for any measured variable.